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CASE STUDY REPORT

The Verdict is in on the Ada County Courthouse

Executive Summary

The Ada County Courthouse is a new five-story 330,000-square-foot building in downtown Boise, Idaho. This multi-use facility contains courtrooms, assembly and hearing rooms, secure holding areas and administrative space, as well as retail stores and underground parking.

The County looked at commissioning as both a quality assurance measure and a way to keep the project on schedule. As the County's representative on the project, Dave Logan, explains, "Because court dates are determined up to a year in advance, we needed our building up and operational on day one. We saw commissioning as a tool to get us what we wanted it."

Project at a Glance

Facility	Ada County Courthouse
Location	Boise, ID
Facility Type	Mixed use – office, retail, parking
Size	330,000 square feet
Construction cost	$47,000,000
Utilities	Idaho Power, Boise Geothermal, Intermountain Gas
Project Description	New building commissioning
Energy Savings	$25,500 per year[1]
Non-Energy Benefits	$106,590[2]
Commissioning Cost	$220,000[3]
Commissioning as % of Construction Cost	0.5%

[1]Annual energy savings based on cost of electricity of $0.0494/kWh and natural gas of $0.75/therm.
[2]Cost reduction or avoidance.
[3]Commissioning provides fee only.

The County chose CH2M HILL, a multinational engineering, construction and operations firm, as the commissioning provider. CH2M HILL was already involved in the project as the construction manager, knew all the parties, and had a good relationship with the County and a proven track record in providing commissioning services. As Dave Logan says, "It was an easy jump for us."

On this project, commissioning was introduced after the design-build firm was selected and design documents were almost complete. As a result the County, the commissioning provider and the design-build firm worked together to accommodate the commissioning requirements. This was accomplished through a series of meetings that included all parties and resulted in a Commissioning Coordination Plan specifying each party's responsibilities. The County's facility staff was an instrumental member of the commissioning team and took on many of the responsibilities often reserved for the installation contractor, including the documentation of quality control checks at each phase of the project.

Although the design documents were already well underway when the commissioning provider was brought on board, the commissioning process did include design review, during which the commissioning provider performed a multi-discipline evaluation of the facility's structure, envelope, mechanical, plumbing, HVAC, electrical and security systems. After construction the commissioning provider reviewed the installation, performance, training and O&M documentation for each of the building's systems.

The commissioning process yielded 250 comments on the design documents and 97 total findings during construction. These design enhancements and corrections during construction were estimated to provide $25,500 of yearly energy cost savings. With the commissioning provider's fee of $220,000 the simple payback for the Ada County Courthouse is 8.6 years. The payback period is only 1.9 years when indirect costs and benefits, for example the cost of facility staff time and the cost benefit of avoided change orders, are also included in the calculation.

"Because court dates are determined up to a year in advance, we needed our building up and operational on day one. We saw commissioning as a tool to get us what we wanted when we wanted it."

- Dave Logan
Director of Operations, Ada County

Introduction

Construction on the 330,000 square foot Ada County Courthouse began in 2000 and the County took occupancy in January 2002. This five-story multi-use facility contains courtrooms, assembly and hearing rooms, secure holding areas and administrative space, as well as retail stores and underground parking. The new courthouse replaces a 60-year-old facility that had life safety code issues, inadequate heating and cooling systems, an outdated electrical system, and was too small to meet the county's needs. The new courthouse brings under one roof County departments previously housed in three different buildings throughout downtown Boise.

The County chose to commission the project as both a quality assurance measure and a way to keep the project on schedule. As the County's representative on the project, Dave Logan, explains, "We

looked at commissioning as a tool to help get what we wanted when we wanted it. This was really important because the facility includes the County courtrooms and court dates are set up to a year in advance. So not only did we need to coordinate a major move from three downtown office complexes to one consolidated building, but we also needed the facility fully operational on day one. The nuts and bolts of County government cannot afford to be down."

The courthouse facility's mechanical system includes two rotary water-cooled chillers and cooling towers, two gas-fired boilers backing up a geothermal hot water heat exchanger, two large variable volume air handlers with single-duct variable air volume fan-powered terminal units with water reheat coils, and some cooling only units. The building automation system is an Alerton DDC system.

Commissioning began in August 2001 and was provided by CH2M HILL of Portland, Ore. The project team included the design-build contractor, Ada County facility staff and the Idaho Energy Division.

Commissioning

What is it?

Commissioning is a quality assurance process for new construction and installations. It helps ensure that building systems are designed, installed, functionally tested, and capable of being operated and maintained according to the owner's operational needs. In return for investing in commissioning, the building owner can save money during construction and on future operation and maintenance expenses.

When does it occur?

Commissioning activities can occur during each phase of design and construction. Ideally, commissioning begins as the owner is beginning to plan the project (pre-design) or early in the design process, and continues throughout the design, construction and warranty phases of the project. Although bringing the commissioning provider on board earlier in the process may result in higher commissioning provider fees, the long-term cost benefits of early involvement are significant. Potential problems are often diagnosed while still on paper and are thus less expensive to rectify than when discovered during construction. Projects where commissioning begins during construction still benefit from the reduction in costly change orders, start-up problem-solving, functional testing and documentation, and operation and maintenance training and documentation tasks.

What does it do?

Commissioning implements a systematic process to verify and cross-check building performance from pre-design through warranty, increasing the likelihood that a newly constructed building will meet

A properly commissioned facility has several advantages over one that is not commissioned.

These may include:

- Improved coordination between design and construction teams
- Fewer change orders during construction
- Fewer call-backs after occupancy
- Improved indoor air quality, occupant comfort and productivity
- Lower energy bills
- Reduced operations and maintenance costs
- Better trained building staff
- Improved building value resulting from increased net operating income

client expectations. Commissioning integrates and enhances the traditionally separate functions of design peer review, equipment startup, control system calibration, testing, adjusting and balancing, equipment documentation and facility staff training, and adds the activities of documented functional testing and verification.

The Process

Commissioning at the Ada County Courthouse followed a common course that reveals both the adaptability and value of the process. The County decided to commission the project late in the design phase after the design documents were nearly complete and ground had been broken. Since a contract was already in place with both the design-build firm and the construction manager, all parties worked together to assume responsibility for the commissioning requirements.

The County chose CH2M HILL, a multinational engineering, construction and operations firm, as the commissioning provider. CH2M HILL was already involved in the project as the construction manager, knew all the parties, had a good relationship with the County and a proven track record in providing commissioning services. As Dave Logan says, “It was an easy jump for us.”

The provider’s first task was to develop a commissioning specification and plan. Upon review, the design-build contractor found many of the requirements considerably beyond the scope of their contract documents. Since the County did not want to issue a change order to add commissioning responsibilities to the contract, the commissioning provider resolved the issue by developing a Commissioning Coordination Plan. This document specified each commissioning task and who would perform it, with reduced and streamlined requirements for the design-builder. In this way the commissioning provider accounted for the quality assurance procedures the design-build contractor *was* willing to perform, and spelled out which parties would be accountable for the rest.

The Coordination Plan helped the commissioning provider map out each party’s role in the commissioning process and provided a written record of responsibilities. The design-build contractor agreed to participate in a controls integration meeting, demonstrate that each system functions appropriately by performing functional tests supervised by the commissioning provider and provide documentation about systems operation. The County’s facility staff assisted the design-build contractor in documenting all quality control checks during installation, start-up and initial checkout.

The commissioning provider’s work began with a multi-discipline review of the design documents. The provider examined the structural, envelope, mechanical, plumbing, HVAC, electrical and security systems. Although the design documents were nearly complete when the provider came on board, the review yielded 250 comments, many of which were resolved by the designers and resulted in approximately $11,000 in cost savings from avoided

change orders during construction. The commissioning provider's comments included suggestions for minimizing problems during installation, reducing change orders and preventing operational and maintenance problems. The provider also suggested ways to enhance the design, reduce waste, and lower first costs. As the commissioning provider says in the Final Report, "The design review was considered a success, as many valuable comments were provided and the designers responded in writing to each comment."

During construction, the commissioning provider verified that each system and assembly was installed correctly and performing as specified. The provider evaluated the training materials provided to facility staff and the O&M documentation delivered by the design-build contractor. The commissioning provider also developed an integrated training plan that included specific training objectives and key items for each piece of equipment. On this project, the traditional commissioning tasks of verifying equipment specifications and evaluating how well the project meets design intent were not included in the scope of work.

Examples of the commissioning provider's findings include:

Air handlers

The provider found a total of twenty-eight air handler issues, including mold in the return air plenum, damaged cooling coil fins and freeze stat wiring, variable speed drives not operating in bypass, pressurization problems and unnecessarily high minimum outside air. Significant energy savings resulted from an analysis of trend data indicating that the main air handlers were on all night. The provider did not see any reason for the fans to run continuously during unoccupied periods, especially on mild nights like those during the trend period when outside air temperature was 55F. Considering that the sequences stated that the air handlers would not come on during unoccupied periods unless there is a 20% average demand for cooling or if a single zone has a 95% cooling call, the provider knew there was a problem. In the end a simple solution saved energy - the contractor increased the unoccupied setup setpoint for the air handlers.

Heating water pump

The commissioning provider used a trend log graph to identify inefficiency in heating water pump operation. The provider found that the pump speed never fell below 40 Hz or 66% speed, wasting energy at night when the pump should cycle only as needed (for example, if there is a significant call for space heating). Trend data also showed that even at night with hardly any load, and even when most heating valves were probably closed, the heating water pump needed to run at 66% speed to maintain the differential pressure setpoint, an indication that the setpoint was too high. The contractor resolved the issue by adjusting the building automation system sequences to enable the pump only when the building is occupied, unless there is a call for heating. The differential setpoint was also lowered to reduce unnecessarily high pump speeds.

As the commissioning provider says in the Final Report, "The design review was considered a success, as many valuable comments were provided and the designers responded in writing to each comment."

Chillers and air handlers

Trend log analysis indicated a significant problem - both chillers were coming on unnecessarily in the morning and the air handler's outside air dampers and economizers were not remaining open when they could be providing free cooling. The dampers should open to provide free cooling when morning outside air temperatures are between 55F and 60F. Their failure to open resulted in unnecessary energy use because the chillers were being used to cool the space. The contractor adjusted the control system and made the air handler economizer the first stage of cooling and locked the chiller out of first stage cooling, solving the problem.

After occupancy the commissioning provider supervised seasonal testing of the mechanical systems. The boiler, heat exchanger, air handlers and rooftop packaged units were tested just before occupancy in December 2001 and January 2002. In May 2002 the commissioning provider returned to test the chiller system, building automation system and air handlers. At this time the provider also verified that findings from the initial tests had been corrected.

Costs and Benefits

The commissioning provider made a total of 97 findings, which can be divided into six groups: design review, sequences of operations and scheduling for chillers, boilers, cooling towers, air handlers, terminal boxes and other mechanical equipment. Of these findings, seven were deemed significant and all were resolved. Table 1 on page 7 details the costs and benefits, Table 2 provides a summary with payback periods.

On this project, the County realized benefits of commissioning that extend well beyond cost savings. Commissioning provided the County with an integrated training schedule for O&M staff and ensured that the facility was completed and 100% operational on time.

Table 1. Commissioning Cost/Benefit Details

Description	Amount	
	Cost	Benefit
Direct Costs		
Commissioning provider fee	$220,000	
Extra drawing reproduction	$3,000	
Indirect Costs		
In-house labor (facility staff & management)	$12,100	
Additional contracted labor	$11,000	
Energy Savings[1]		
Electricity savings		$22,700
Natural gas savings		$2,800
Non-energy Benefits		
Avoided change orders		$16,930
Increased occupant comfort		$27,800
Reduced operational deficiencies		$15,240
Fewer start-up problems		$ 9,860
Other benefits		$36,760
Total Costs	$246,100	
Total Benefits		$132,090

[1]Annual energy savings based on cost of electricity of $0.0494/kWh and natural gas of $0.75/therm.

Table 2. Commissioning Cost and Benefit Summary

Cost/Benefit Type	Cost	Cost Savings	Payback
Commissioning provider fees + energy savings (simple payback)	$220,000	$25,500	8.6 years
All costs and benefits	$246,100	$132,090	1.9 years

Conclusion

At the Ada County Courthouse, commissioning was about more than simple cost savings. As Dave Logan explains, "Our moving schedule was created approximately twelve months in advance and we met it to the day. I think commissioning helped us do that. And more importantly, once we got here our building performed as it was intended to perform. Our people were well trained to operate the building. From the mail room to the parking attendants, everyone got the training they needed."

Acknowledgements

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